In the specification:

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A functional printed circuit board (PCB) module in accordance with the present invention integrates a chip into a PCB to decrease the PCB module total thickness.

With reference to Fig. 1, the functional printed circuit board (PCB) module in accordance with the present invention comprises a frame (10), at least one chip (20), at least one printed circuit (12) and insulation material (111). The frame (10) has two sides (not numbered) and at least one chip ~~recess~~ hole (101). The chips (20) correspond respectively to the chip ~~recesses~~ holes (101), and a chip (20) is mounted in the each chip ~~recess~~ hole (101). One printed circuit (12) is formed on one side of the frame (10) and connects to the chip (20). Each chip ~~recess~~ hole (101) is filled with insulation material (111) and encapsulates the chip (20), so the chip (20) is embedded in the frame (10). Therefore, the present invention provides a functional PCB module having an embedded chip.

A first embodiment of the functional printed circuit board (PCB) module in accordance with the present invention comprises a frame (10), a printed circuit (12), one chip (20) and insulation material (111). The frame (10) has two opposite two sides (not numbered), is nonmetallic and has one chip ~~recess~~ hole (101). The printed circuit (12) is formed on one side. The chip (20) has a top face (not numbered) and multiple terminals (not numbered) and is mounted in the chip ~~recess~~ hole (101). The terminals are formed on the top face and face upward toward the printed circuit (12). The printed circuit (12) on the frame (10) is connected to the chip (20) in the chip ~~recess~~ hole (101), and the chip ~~recess~~ hole

(101) is filled with insulation material (111).

With reference to Fig. 2, a second embodiment of a functional PCB module in accordance with the present invention is similar to the first embodiment, but the frame (10) is metallic and further includes an insulation layer (11).

The insulation layer (11) has multiple through holes (13) and multiple plugs (14) and is formed between the frame (10) and the printed circuit (12). The multiple through holes (13) correspond to the terminals of the chip (20) and are defined through the first insulation layer (11). Each plug (14) is formed in the corresponding through hole (13) to connect to the chip (20) and the printed circuit (12).

Further, if the metal frame (10) is connected to a ground and the printed circuit (12) has to be connected to the ground, at least one electroplate via (15) is formed through the printed circuit (12), the insulation layer (11) and the frame (10). The printed circuit (12) is connected to the ground through the electroplated via (15) and also has good heat dissipation.

The first and second embodiments apply to single-sided, and single-layer functional PCB modules.

With reference to Fig. 3, a third embodiment of a functional PCB module in accordance with the present invention is a double-sided, single-layer functional PCB module and comprises a frame (10), at least one chip (20), a first and second insulation layer (11, 17), a first and second printed circuit (12, 18), insulation material (111) and multiple vias (15). The at least one chip (20) has multiple terminals. The frame (10) has at least one chip ~~recess~~ hole (101) and

two opposite sides (not numbered).

The first insulation layer (11) is formed on one side of the frame (10) and has multiple through holes (13) and plugs (14). The through holes (13) correspond to the chip (20) terminals, and the plugs (14) are formed respectively in the corresponding through holes (13). The first printed circuit (12) is formed on the first insulation layer (11). The second insulation layer (17) is formed on the other side of the frame (10), and the second printed circuit (18) is formed on the second insulation layer (17).

The multiple vias (15) are defined through the first printed circuit (12), the first insulation layer (11), the frame (10), the second insulation layer (17) and the second printed circuit (18) and selectively may have insulation wells (151). Thus, each via (15) electrically connects the first printed circuit (12) to the second printed circuit (18). Unless an insulation well (151) is implemented, the via (15) is also connected to the metal frame (10).

To insulate the via (15) from the metal frame (10), an insulation well (151) is formed around the selected via (15) between the first and second printed circuits (12, 17). Therefore, the via (15) is insulated from the metal frame (10) and is connected only to the first and second printed circuits (12, 18).

With reference to Fig. 4, a fourth embodiment of a functional PCB module in accordance with the present invention has another connection between the chip (20) and the first and second printed circuits (12, 18) that is different from the forgoing preferred embodiments.

The chip (20) has multiple solder bumps (21) is mounted in the chip ~~recess~~ hole (101) with the top face with terminals facing downward. The solder

bumps (21) are formed respectively on the terminals on the chip (20). The solder bumps (21) are attached to the second printed circuit (18). Thus, the chip (20) is connected to the first printed circuit (12) through the via (15) that connects the first and second printed circuit (12, 18).

With reference to Fig. 5, a fifth embodiment of a functional PCB module in accordance with the present invention provides another connection between the chip (20) and the first and second printed circuits (12, 18). The chip (20) is mounted in the chip ~~recess~~ hole (101) with the top face and the terminals facing the first printed circuit (12). The terminals on the top face are connected to the second printed circuit (12) by wire bindings (not numbered) embedded in the insulating material (111) in the chip ~~recess~~ hole (101). Further connection of the chip (20) to the first printed circuit (12) is made through the via (15) between the first and second printed circuits (12, 18).